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Nijkamp, P.; Jonkhoff, W.

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Peter Nijkamp
Wouter Jonkhoff

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THE CITY IN THE INFORMATION AND COMMUNICATION TECHNOLOGY AGE: A COMPARATIVE STUDY ON PATH DEPENDENCY

Peter Nij kamp
Wouter Jonkhoff

The role of the city in the modem electronic age is rapidly changing. Cities are no longer closed islands of local opportunities, but are open nodal points in a global network environment. The Information and Communication Technology (ICT) has lifted the traditional physical – geographical constraints which kept cities imprisoned since the early genesis of modem cities. More openness means also more actors in the global economic playing field, so that cities tend to become increasingly competitors of each other. In such a competitive game between cities the success conditions are largely determined by the adjustment potential, and the flexibility and resilience of several stakeholders in urban life. The paper analyses the causes and implications of urban path dependency and tries to offer an analytical framework through which actual developments in various cities can systematically be mapped out. The paper proceeds then – by way of a comparative contrast analysis – with an empirical investigation of two dynamic cities, Berlin and Amsterdam. Based on extensive field work, an attempt is finally made to offer clear policy conclusions and recommendations for urban ICT policy.

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1. Setting the scene

In the history of mankind cities have always played a crucial role. City formation was often a result of political, socio-cultural en economic forces and was essential for the dynamics of an economie-geographic system. City size was often contingent on the prevailing technology, such as water provision or transport systems. Lack of appropriate technology has in many cases of urban history almost meant an impediment to further urban growth. In our modem age information and communication technology (ICT) may act as a new driver for urban dynamics.

At the beginning of the new millennium economies in general, and cities in particular, exhibit an unprecedented dynamics, offering new threats and opportunities. Cities have become sources of hope and concern. A large part of the European Union is, compared to other developed economies, persistently suffering from unemployment (Castells 1996). Particularly cities exhibit considerable employment losses. This has generated various responses from the side of urban policy-makers. There are many cases where local administrations try to attract firms by refraining from taxing them in various ways (Berkhout 1999). These regions are generally located at the edges of the EU, covering Ireland, the British Midlands, the Northem part of the Netherlands, the Walloon region, France, the Basque area, Finland, Southem Italy, Greece and East Germany. Sometimes a true fiscal paradise is created, where enterprises do not have to pay any taxes on profit. These regions belong generally to the poorest ones in Europe. The same applies to cities: mostly, industrial cities and port towns are involved in such revitalization policies (Van den Berg et al. 1998). These places suffer often from so-called dis-urbanisation and high unemployment figures. At the same time, Europe's main cities, such as Paris and London as well as the Dutch Randstad and Southem German cities, amongst others, experience a phase of new prosperity.

This paper aims at contributing to an explanation of the different dynamics of modem cities, and to suggest policy perspectives for urban administrations conceming modem unemployment policy. The basis of our investigation is formed by the notion of a technological revolution and of subsequent path-dependence in the development of urban economies. It is undoubtedly true that economic history has been radically modified by various technological revolutions. It is remarkable how much the Industrial Revolution and the Electric Age have impacted on the last century. It seems plausible that a new revolution, i.e. the ICT revolution, will determine the face of the new millennium. To assess the ICT impacts on urban development, we take for granted that current conditions may be the outcome of smal1 events in (possibly remote) history. Against these background observations, we address in this paper the question: which are the perspectives of urban development policy, in the light of the ICT revolution?

In order to assess the urban consequences of the ICT revolution, it is necessary to identify its characteristics. It is useful to offer first some definitions of information, transaction costs and 'economic revolutions' from an ICT viewpoint.

We may refer here to Machlup (1983) and Ouwersloot (1994) for a treatment of information, data, knowledge, meaning and known conventions. Knowledge is essentially an accumulated stock of information based on synergy, while information refers to structured flows of data (numerical or symbolic description of phenomenon). Thus knowledge results from the adding, (re)structuring, editing, and other operative changes caused by the flow of information. Information is usually part of a communication process aimed at improving insights into (partly) unknown aspects of a phenomenon.

The often adopted assumption of perfect information (e.g., in neoclassical analysis) is highly questionable against the background of actual behaviour in which uncertainty and risk taking is rather common. If the information process were free of costs, information would - within the borders set by technology - always be completely available. But this is not the case. Transaction costs lower the price the demander is willing to pay, and raise the price the supplier wants to receive. In both cases social welfare is affected.

First, there are costs faced by the demander of information. He/she has to decide what information is needed, and has to search for the relevant information conceming prices, quantities, quality, and the consequent possible set of suppliers. After information is acquired, a decision has to be taken. The less information is available, the more time and costs have to be spent in the decision-making process. We will denote here the demander's costs as information search costs.

Secondly, we need to consider the costs faced by the supplier of information. The consumption of information does not limit others in consuming it; the character of information is non-rival. *"When the supplier of infomation communicates a part of his knowledge, this does not reduce his own knowledge"* (Ouwersloot 1994, p. 22). But since having a knowledge surplus offers the opportunity to exercise power (i.e., to benefit from asymmetric distribution of information), spreading knowledge might depreciate the suppliers's relative position. The supplier of information cannot be sure whether the demander will act to his/her benefit. Furthermore, the information sent by the supplier has to bridge spatial and perceptive (i.e., social, cultural, etc.) distance. It should thus be edited in order to provide the demander with the perception that is pursued by the supplier (Ouwersloot 1994). When a transaction is agreed, the supplier has to see to it that the transaction is carried out. In other words, he/she has to enforce the demander to pay the price agreed.

The information process is closely connected with choice. The goal of engaging in the process is making an optimal – or at least better – choice. The receiver of information goes on gathering information, as long as the expected benefit exceeds the costs. As expectations might turn out to be not correct, it follows that the receiver might stop looking for information when it is actually stil1 better to obtain more.

The importance of information and knowledge is enforced by the technological revolution in the ICT sector (see Castells 1996). Communication and information can be subject to technological changes, since they are essential to man's coping with nature. It is important to distinguish between technological change and diffusion of wealth. Technology sets the bottom to transaction costs. If technology enables transaction costs to fall, social welfare can increase. The former does not mean that the latter occurs immediately and everywhere, as the Industrial Revolution showed (Castells 1996). So the revolutionary element is not primarily in the diffusion of wealth, but in the *shift* of the technological boundary to wealth creation. Wealth creation is not only subject to technological possibilities, but also to political, social, institutional and cultural circumstances, since they provide an economic order (North 198 1).

In human history, periods of gradual change are sometimes interrupted by rapid, shock-wise developments. This can be said of the Industrial Revolution (the steam engine, the railway locomotive, the factory system) and the revolution of the second half of the nineteenth century – the Electric Age (R&D laboratories, electricity, metallurgy) (Kranzberg and Pursell 1967; Castells 1996). Kranzberg and Pursell (1967) argue that when man settled, this was the start of civilisation because man *"could not afford to live in constant conflict"* anymore. So this was a point where, since collaboration became unavoidable, the necessity of information and communication increased dramatically. In a transaction costs approach, one could say that costs were lowered, because it became possible to trade on the basis of trust.

Since the mid 1970's we have witnessed a rapid technological change in the field of information processing, in particular in regard to its speed and capacity. In this context the term 'Information and Communication Technology (ICT)' is remarkably well chosen. In contrast to its predecessors, the ICT revolution is characterised by the *interplay* of information and technology, rather than just technology improving information processing. To identify ICT, we refer to machines that are just there to store, process and transmit information. Information has become a marketed product itself, and the common definition of information technologies is "the converging set of technologies in microelectronics, computing (machines and software), telecommunications/broadcasting, and opto-electronics" (see Castells 1996). The leve1 of information processing made possibly by these products enables further technological inventions. These machines take over in a rapidly increasing number of households and enterprises. The increased centrality of information for economic activity renders the new technologies essential, and accounts for the pervasiveness of the ICT revolution.

The ICT revolution is signified by major changes in labour, capita1 and product markets. Just as the Industrial Revolution gave rise to the industrial society, that is to say, socialisation of work and salarisation of wages, the ICT revolution leads to the information society, with its own characterisation of work. The organisation of work is deeply changed, moving toward – as Castells (1996) – writes 'the individualization of labor in the labor process'. Life long leaming and 'employability' become crucial factors for employees, as knowledge becomes crucial for productivity, and innovation becomes

decisive for value added. Repetitive tasks in the work process can be automated, rendering traditional institutions such as lifetime job and salarisation of work obsolete. The stress is on decision-making, not on assembly lines. When enterprises become networked in a global economy and when the scope of possibly profitable transactions comprises the whole world, it is favourable to be 'footloose', to be able to locate wherever it is most profitable to do so. In other words, existing job security institutions may become brakes on new possibilities for profit generating.

It seems fair to conclude that an economic revolution is taking place because of rapid technological change with consequences influencing the core of human economic activity. ICT is the source of it. It is important to identify changes in the work process that are connected with the ICT revolution. The latter is the technological basis for the trend in job relations towards a loose, network basis: the individualisation of work. It is noteworthy that the implementation of ICT revolution-connected work processes interacts with institutions at various geographical levels. This leads US into an exploration of the opportunities at an urban level.

2. Challenges to Urban Policy

In this section we will address more specifically the spatial component – in particular the urban component – in the ICT revolution. The Industrial Revolution positioned the city already in the centre of an economie-technological force field. The 'marriage of science and technology' (North 1981) generated high returns for modem cities, a position which was significantly enforced in the Electric Age. In the second part of the twentieth century we have witnessed the emergence of sub-urbanisation and tertiarisation, which meant often an erosion of city centres but a reinforcement of metropolitan areas. The rise of the ICT sector will mean another challenge to urban policymakers at the beginning of the new millennium, especially because the skills requirements for ICT workers will lead to an upgrading of urban employment (occupational training, education, and on-the-job learning). Consequently, also migration policy may become an important tool in an ICT driven city.

Improving the efficiency and transparency of the labour market is a logica1 instrument as well, though mainly based on institutions requiring national action for change. They are often not subject to the competence of urban policy but to national govemments. Finally, it is possible to try to relocate the demand for labour. Taxes and subsidies can be used to attract investors by either supporting input or output. The former support can take the form of wage subsidies, capita1 investment subsidies, or other resource-based support such as energy cost reductions. The latter measure includes buying products by the public sector and price subsidies, while also administrative planning restrictions can be relaxed or bureaucratic processes simplified. Consulting can be applied as well.

Labour market policy in Europe is mainly exercised at the national level. All EU countries have a system of unemployment benefits. The employment disincentive that might occur as an obvious result is clear; workers might have an incentive to quit their jobs, and the unemployed might have an incentive to stay unemployed. On the other hand, one could argue that the income safety provided enables the unemployed to search longer for a more suitable job, increasing labour market efficiency. Targeted policies can influence employment more directly, involving less dead weight loss, i.e. subsidies to those who would have been employed anyway. They can assume different forms. First, *employment subsidies* can be used to increase demand among groups experiencing persistent unemployment (for example, youth unemployment and long-term unemployment). Second, *job guarantees* might benefit the long-term unemployed. The form of unemployment under consideration here is especially disadvantageous, because qualification decreases with the period one is unemployed. Long-term unemployment is persistent; it declines only very slowly after economic recovery has set in (see Fallon and Verry, 1988). Third, *work sharing* might be practiced, be it by means of early retirement, splitting jobs, or shorter working hours. The problem here is that no net employment increase occurs; meanwhile fixed labour costs rise. Firms and employees must be compensated, and the net costs of the measure are thus high. This situation occurs widely in Europe, especially with respect to early retirement.

The labour market requirements of the information society are quite different from those of the industrial society. The importance of certain factors declines, whereas other factors gain importance. Let US take a look at the factors facing enterprises. The proximity to natura1 resources is no longer a necessary requirement, because in many instances the wage differential between a European location and a location with low wages (for example, in South-East-Asia or Eastem Europe) compensates for

the extra transport costs. Promising sectors in the information economy are not dependent on physical work; it can be automated. Employment that cannot be replaced by machines becomes increasingly important. The emphasis shifts towards those tasks that are non-programmable, where the human rnind masters computers. The tasks involved with decision-making gain importance. So the existence of a well-educated labour force replaces the proximity of physical labour as a geographical factor. But even this picture appears, in a theoretical setting, irrelevant. Supplier and demander are mostly not required to be at the same physical place for the economic transaction to be carried out.

For example, ICT makes working at home at flexible time schedules ever better possible. It seems appropriate in this context to deal concisely with telework. This possibility is, like many features of the ICT revolution, not new. Rather, ICT enables it to be a more realistic alternative to large groups of the workforce. After all, besides imposing problems of superfluity on cities, it may serve as an instrument to relieve typically urban problems like traffic congestion and lack of space. Location and environmental factors could be improved by it. Employers could save costs. Employees could improve the co-ordination of occupational and family activities. Bratzel en Dienel (1999) mention the following urban implications:

- The number of centrally located companies can decrease dramatically
- Micro-firms can evolve
- Virtual companies with (partly) global interconnections can arise

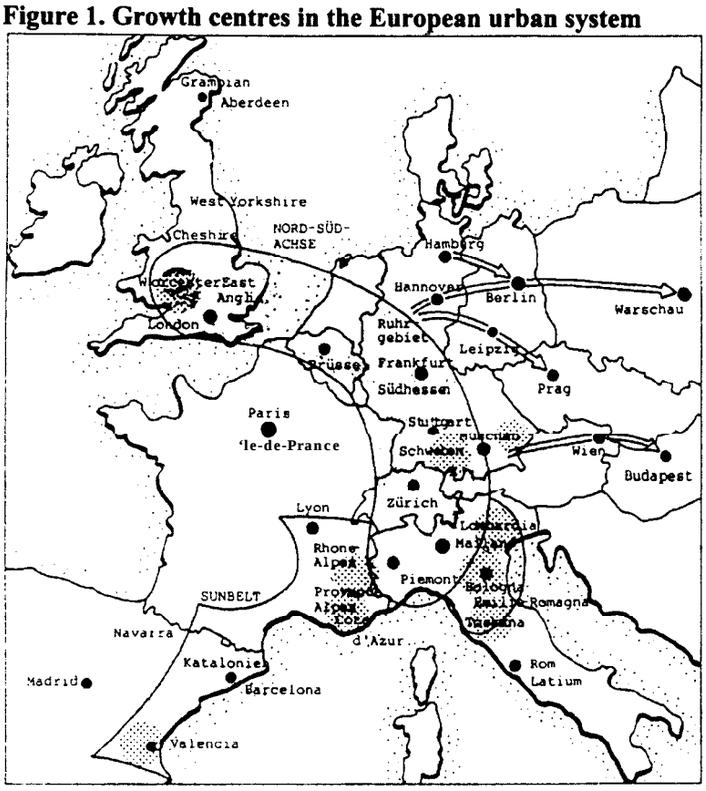
Hence the condition of qualified workers in the neighbourhood of the production site becomes less relevant. At least, the possible radius of location is enlarged. Furthermore, due to the increased scope of competition induced by the ICT revolution, employers want job relations to be more flexible. So institutions addressing this matter are of importance when looking for location altematives.

Today the characteristics of cities are very different from medieval times, but stil1 the city has, because of its many inhabitants, a fluid labour market (Sassen 1994). So it is relatively easy for employers to keep their production processes at the preferred size. For cities, it means that unemployment can differ enormously. The case for targeted policies focusing on increasing demand in sectors with overrepresentation of unemployment is thereby enforced.

On the other hand, the city attracts those who are less interested in job security (e.g., migrants), because getting access to employment is easier. The increasing opportunities offered by ICT affect the importance of suppliers to the citizen, too. It becomes less important to live near retailers. With the (theoretical) possibility of telework and flexwork, the distance to jobs is far less important. The average citizen can be described as eaming enough to be highly mobile, so choosing a place to live on "weak" criteria (such as quiet environment in suburban quarters, or the busy excitement of inner cities) becomes possible. But the developments involved lead to polarisation, both *within* and *between* cities.

In exploring the perspectives for urban employment and policy in our ICT age, it may be interesting to see how cities perform in the European urban system. In which urban areas does economic growth concentrate, which industrial cities can and cannot keep up with current trends, and how do cities depend on each other? Various studies have tried to identify urban systems in Europe (see Krätke 1995; Bratzel en Dienel 1999). They identify mainly two economic growth regions, the first from London via the Dutch Randstad, the Rhineland to northem Italy (called the 'Blue Banana'), the second along the mediterrean coast, covering Milan, Barcelona, Grenoble and Valencia. It is called the 'Sunbelt' region. Figure 1 provides an overview of this spatial – economic force field in Europe.

Figure 1. Growth centres in the European urban system



Source: Krätke, p. 134

Urban networks are becoming less nationally oriented. Cities that were once at the periphery sometimes are at once central. It seems that a widening gap can be seen between those cities that connect to the global network, and those that do not (Sassen 1994). Peripheral cities and old port cities apparently have lost ground. Of course, this cannot be said of all old industrial cities. Some of them reappear with new fùnctions. Many authors identify genera1 trends to construct a division, or hierarchy, of European cities. Castells (1997, pp. 112-4) divides between

- Metropolises, which gain power, because in these places centra1 decisions are made
- Declining old industrial cities apparently incapable of adjusting to the new technologies and activities
- New regions attracting capita1 and labour, and becoming dynamic economic centres.

Krätke (1995) has made an interesting distinction, where he draws on the quality and radius of control capacities of firms and specialisation in innovative or traditional activities in the city. He identifies the following types:

1. Global cities – intemational control centres with concentration on high-qualified services. Examples: London, Paris
2. European metropolitan urban regions – concentration on European activity where products can be innovative or industrial. Examples: Brussels, Berlin, Amsterdam, Milan, Stockholm
3. Nationally important urban regions – locations of intra-national/regional services and enterprises where products can be innovative or industrial. Examples: Lyon, Barcelona, Copenhagen, Prague, Rome
4. Cities with specialisation on innovative production structures – concentration of firms with flexible, networked production relations and a large supply of production-oriented service. Examples: Stuttgart, Bristol, Cambridge
5. Cities with specialisation on standardised mass production – concentration of extemally controlled enterprises with traditional industrial organisations. Examples: Porto, Manchester, Thessaloniki
6. Marginalised urban regions – decline or lack of surviving industrial production enterprises with low supply of production-oriented services, and a large informal economy. Examples: Naples, Palermo.

It is clear that cities have not disappeared at all. Large cities are even growing (Sassen 1994). So a view proclaiming the end of cities is certainly not correct, or has to be geared to special effects. Earlier economic revolutions were not accompanied by immediate population and employment responses. Computers may be fast, but people adjust gradually. In our telework example, it may be interesting to have a look at the possible antagonists of telework (see Table 1).

Table 1. Objections against telework

Enterprise decision makers	*Individual managers*	*Teleworkers and potential teleworkers*
Unaware of the rationale for telework; lack of pressure to adopt telework	Absence of a clear company policy	Management seen as unsupportive or resistant
Concerns about middle management to cope with change	Perceived difficulty in "managing at distance"; fears about loss of control	Concerns about impact on career – concern that "being out of sight" will mean being out of touch
Reluctance to add to the topics being discussed with Unions	Uncertainly about employment contract implications and employees responses	Confusion about relative responsibilities of individual, manager and company
Difficulties in supporting widely dispersed home-based employees	Perceived and actual problems in communicating with employees	Practical concerns about home-based working – family impact, spatial availability, differentation between work/private life

Source: European Telework Development (1998, p. 302)

European Telework Development (1998) reports that, apart from difficulties in the measurement of telework, it seems clear that it is only slowly adopted in Europe. Helten and Fischer (1999) come to fairly similar conclusions. Antagonists of telework provide a good example of the power of special interest groups; many people simply do not want to work at home.

Particularly strong institutions conceming the labour market seem to be at work in Europe, rendering it rigid from an ICT-based viewpoint. Apart from that, man needs interaction with man. Increased mobility causes extra possibilities toward profitable economic transactions. As computers cannot replace personal interaction, the spatial outcomes of the possibilities toward making these profitable transactions, i.e. the cities, grow.

As far as the ICT revolution enhances possibilities for profitable transactions in an economic sense, actors' preferences are likely to become more divergent, and the possibilities of governments to adjust the behaviour of actors become, indeed, restricted. Thus, firms and citizens are highly volatile conceming their preferences, whether the implications are spatial, financial, or work-related. Moreover, information is the source of economic action by self-interested individuals. As they are able to dispose over large amounts of information, it becomes increasingly diffrcult for the state to know which information they possesses. Subsequently, the state cannot anticipate, or steer economic action. Indeed, the amount of products is enlarged dramatically, and traded electronically. The virtual character of such trade makes policy very difficult to implement. In addition, the global scope of economic transactions is not restricted by national boundaries. Whenever national policy is not convenient for an entreprise, it can quite easily move its actions to other countries, with the concomitant loss of employment and public income. To be sure, complete footlooseness is not reached by global markets. Workers are restricted in their mobility, and face-to-face contact remains central. But economic actors avoid transaction costs. The global scope of trade provides these actors with an

increasing number of altematives when transaction costs appear in the form of taxes or quantity restrictions.

The future trend will be, in the light of the developments set out alone, a logica1 development from industrial modes of decision-making toward networking and an individual approach. Urban administrators will recognise that standardised, hierarchical, centralised, quantitative, exclusive measures are not appropriate. When trying to maximise the financial base, individual preferences need to be taken into account. Institutions adapt only gradually to the new paradigm. The nation state loses competence, but stil1 dictates the pace of urban physical planning and labour market policy, though a trend toward decentralisation can be observed, strengthening competition among cities. The urban administration does not function in a perfectly democratic way. Self-interest guides its actors. It is vulnerable to the collective action of interest groups, likely to oppose against the individualised work forms of the ICT revolution. It is not well able to cope with the problems imposed on it. An obvious question is whether urban policy in the next decades will exhibit a sufficient degree of resilience to make the city survive. This will be dealt within the next section.

3. Path Dependence in Urban Development Policy

The economic historian Paul A. David, in his "Clio and the economics of QWERTY", deals with the question how the keyboard with the word QWERTY left on top became as accepted and common as it is. After all, when it is assumed that 40 keys are to be arranged on the board, 10^{48} outcomes are possible, and it has been shown that the QWERTY arrangement is not the most efftcient. David argues that it is not technological superiority that determines the acceptance of products, but *chance*. The QWERTY arrangement was there because it was convenient on the conventional typewriter. As typists across the globe were used to the system, it was adopted for computer keyboards as well. The author defines pathdependence as follows (David 1985, p. 332):

In a genera1 sense, when a product, by chance rather than technological superiority, gains an acceptance lead in early stages of the competition with other products, further acceptance becomes more likely. The process starts to accelerate, and it is very likely that one single producer competes all rivals out. The dynamic result is self-reinforcement. The notion of processing being *Zocked-in* involves that early chance in the process determines in which direction .a market tends to develop. But since the product adopted may not be the best one, because its technology is not selected by technological arguments but by chance, it is in no way clear that the chosen path is optimal. For example, a technology with low initial benefits may prove to be superior as time elapses. But since another technology with large early benefits is chosen, the former does not get the chance of being developed further.

The topic of increasing returns was already noted by A. Marshall in 1890, stating that whenever production costs fall as market shares increase, a firm that by good fortune happens to attract a good deal of the market in the early adoption stage can beat its rivals. It is not a convenient notion in economics, because the assumption of diminishing returns is dropped. The outcome is thus not one of equilibrium; it becomes uncertain, in other words, it is non-ergodic (Arthur 1994, p. 27). It is, however, not unlikely that producing more implies benefiting relatively more. During production, the producer gains experience on how to produce as cheap as possible (learning by doing). Certainly, when considering products with many technological features, this is an important factor. As well, experience can enhance production of similar products with the same technologies (Arthur 1994, p. 4). Because of existing networks and infrastructures, existing users may have only limited possibilities of switching products. Last but not least, as products may be highly complicated in their applications, information contagion may occur.

Indeed, it is commonly assumed that once production is increased, the marginal returns decrease. This may be because of scarce production factors not being capable of being substituted, the effect of increased demand on market prices. Increasing returns thus need further exploration. As Estrin and Laidler (1995) argue, it is not the product itself, but the features attributed to it that yield the consumer the pursued satisfaction. There are several ways – possibly technologically different – to achieve satisfaction. Let US now consider the features of competing products important in determining the possibility of increasing returns. Certainly, increasing-returns goods and services must have some *durability* to imply inflexibility of transaction sequences facing consumers. When consumption of the good is short in time, it is easy to switch in case of unsatisfying results.

Next, products must *compete on different technological features.* To the producers of the goods (assumed they compete), increased demand for the competitor's product is lowering output. They thus compete on prices. If we change this feature, and assume that both products have different technological characteristics (such as fuel for a certain group of cars), the dynamics change. When a car producer sells more cars of the group under consideration, the fuel producer can expect to sell more fuel. To be sure, this case is not convenient yet because when more fuel is sold, it is not an indication that more of the appropriate cars will be sold. Increasing returns apply only to the fuel supplier.

When competing products have the same technological features, path-dependence may occur (for example, due to brand loyalty), but has no implications since in both cases the technological development is the same. Arthur (1994) provides a proper example of increasing returns. In the video-market, selling more video-recorders of a certain type means that more videocassettes will be sold as well. In turn, when more videocassettes are bought and (pre-recorded ones) rented, more people will buy video-recorders of that type. Suppliers of different types of video-recorders are competed out. So when products are complementary (that is to say that they do not sell without each other), increasing returns are possible, because there are compatibility restrictions between the goods provided by competing firms. In other words, there exist network extemalities (Blankart and Knieps 1991): the size of the network of consumers already using the technology is a determining factor with a positive influence on consumers deciding which technology to adopt. As argued above consumers have incomplete information about products with respect to the degree to which they satisfy needs. The transaction costs involved with obtaining more information makes them stop searching for more information once they do not expect this to be profitable anymore. This leaves them with having to decide (partially) on the basis of expectations. It is not sure whether these expectations are the same. They depend on the preferences about the product. Which product has the most satisfying features? When preferences are homogeneous, it is likely that a single supplier, namely the supplier with the most favourable product characteristics, gains all of the market. Once heterogeneity is allowed, the outcome is probably market sharing and monopolistic competition. In both cases, network extemalities are important, because a large network raises the use value of the product.

In short, when a new technological standard becomes available, consumers consider two criteria before they switch networks (Blankart and Knieps 1991):

- The additional utility of adopting the new technology (the *technology effect*)
- The difference in utility corresponding with the number of agents using the new standard (the *network effect).*

The idea is that *critical mass* is attained once sufficient consumers have decided that the technology effect compensates for the (presumably negative) network effect. It is thus in the interest of suppliers to provide the consumer with the perception that this is the case. Is asymmetric information, resulting in adverse selection, the consequence? It seems to be, as producers are likely to have more information about their products than consumers (Estrin and Laidler 1995). But two qualifications have to be added. First, consumers are not just acting on the basis of price information but of technological features. This goes as well for firms. Second, the information available to producers cannot be assumed to be perfect, because, in a dynamic view, products are in early stages of development here. It is perfectly possible that information division is asymmetric, but not necessarily to the advantage of one of both parties (for example, in the QWERTY case).

Products with many technological features confront the potential consumer with a choice problem. When products have to fit into a network, the question of compatibility becomes all-important. More often than not, a consumer has no knowledge about how to connect (for example, computer network systems). The same goes for the amount and costs of maintenance, the degree to which the product can operate, the uses the consumer has in mind, and how to use the product. The amöunt of information needed will in many cases not be available because of high transaction costs of receiving it, and because of uncertainty regarding the supplier's incentives and amount of knowledge. In such cases, it appears logical to ask previous and current users of selected products. Seen as a process, information is consequently spread selectively, as the information that the prospective consumer gets is dependent on the choices made by previous users. Asking all users is impossible; it is too time-intensive, so opportunity costs are too high. Complete rationality would also imply using the information that previous users gathered when they were potential consumers – with the time intensity

sky-rocketing. So let US assume that the potential purchaser only asks previous users without knowing which product they use. In doing so, he/she obtains information about certain products, and these are probably the products with the largest shares in the market. This is called information contagion (Arthur 1994). The consequence of it can be a pathdependent process. The suppliers with the largest shares in the market have the largest probabilities of selling their products, so the process reinforces itself. Although the potential consumer may get information based on negative experiences, known technological features can stil1 provide the potential customer with an incentive to choose the product (this differs with the degree to which consumers are risk-averse, and with network externalities)

As the products enabling the ICT revolution are, indeed, of a complicated technological character, it seems reasonable to say that path-dependence can be observed in an increasing part of product markets. Moreover, the rapid developments with respect to compatibility, processing speed and applications speed up the products' life cycles - the technology affect is omnipresent, and increases uncertainty. The effects are dependent on the degree to which potential purchasers act risk-averse and rational. So path-dependence need not emerge, but the possibilities thereof increase. Information contagion can be seen as a method to lower transaction costs with minima1 loss of private benefits, incorporating considerable consequences for aggregate processes. In the light of the previous remarks, the notion that the economy becomes more subject to increasing returns is no giant leap. Indeed, Karlsson and Larsson (1990) argue that in times of rapid technological change, the share of product competition tends to increase. Product competition is interpreted here, broadly speaking, as competing on technological features of products, and price competition as competing by trying to maintain the lowest possible price. Indeed, ICT is all about technological competition and compatibility. ICT equipment is relatively durable, moreover. Use of personal computers, Internet, and satellite and cable television is, indeed rapidly increasing in the EU (Bratzel and Dienel 1999). But the influence of ICT on consumer's preferences deserves some consideration. If the assumption about consumers becoming more heterogeneous is correct, pathdependence is possible only to a limited degree. On the other hand, the video-recorder and QWERTY instances can be updated by the adoption of Internet software, and differing features serving homogeneous needs in the field of personal computers can certainly be identified. In this context, Karlsson and Larsson (1990) argue that product competing enterprises locate in centra1 regions, and price-competing firms in peripheral regions. This would imply that path-dependence is more likely to emerge in centra1 regions. But peripheral regions are, in this way, dependent on technological development as well. If the argument about ICT-based products competing on technological features is correct, just as the notion of rapid developments in ICT sectors, a process of outsourcing price-competing products to peripheral regions is likely to take place. Positioning the city as a supplier of location, ICT enables enterprises to take less account of geographical factors. Product markets can be found everywhere, but qualified workers are scarcer, and not highly mobile in the European setting. Agglomeration economies exist in this respect. ICT renders transport costs less relevant (though not obsolete, because of increased transactions possibilities), but the highly technological base requires large amounts of knowledge. It seems likely that spin-off effects are among the determinants of the location decision - they can be identified as network effects. Entrepreneurs shift attention toward local financial and institutional frameworks. They stress flexible work relations with respect to transport time and cost, labour regulation, and workforce potential. Indeed, it seems fair to say that agglomeration economies gain importance throughout entrepreneurial economic history, and the ICT revolution is no exception. However, the location process will become more path-dependent. Leading branches of the ICT revolution locate in centra1 cities because these cities offer knowledge potential and a fluid labour market. Only on the basis of knowledge is it possible to exercise control; only a fluid labour market enables flexible work relations. To cities, having established an infrastructure of leading branches makes the process reinforce itself. To conclude, path-dependence offers a reasonable explanation for the polarisation process between cities. The'process is not easily altered, because structures already in place are decisive here. As a result, a spatial hierarchy of cities may emerge (see Table 2).

Table 2. Hierarchy and dynamics of urban regions in two dimensions

Production structure / Control Capacity	Concentration on *innovative* production structures[1]	Concentration on *Traditional* Production Structures[2]	Deficit of traditional and innovative production capacity
Concentration of *International* Control and Finance capacity And high qualified Services'	Global cities (1)		
Concentration of European control and finance capacity And high qualified Services[3]	European metropolitan regions (2a) (2b)		
Concentration of *Regional* control and finance capacity And high qualified Services	Nationally important urban regions (3a) (3b)		
Deficit of control and finance capacities	Cities specialised in innovative production structures (4)	Cities specialised in standardised production functions (5)	Marginalised urban regions (6)

[1] Innovative industrial organisations forms (conform "new technologies")
[2] Vertically integrated, "Fordistic" industrial organisation
[3] Control, finance and services capacity together form "metropolitan complex strategic enterprise activities"
Source: Krätke (1995, p. 141)

Path-dependece may be the reason why Krätke (1995) attritbutes global functions only to London and Paris - it is the outcome of a self-enforcing process impossible to countervail (see as well Arthur 1994). Additionally, Krätke considers only cities with a concentration on innovative production relations capable of moving upward in the hierarchy. The dynamic process envisaged by Karlsson and Larsson (1990) appears to shed light on the urban dynamics; it is more likely for products in the later stages of their life cycles to be outsourced to regions with specialisation on traditional production structures. Hence those regions have opportunities dependent on technological development. The wage leve1 seems to be the main determinant here. Innovative regions, however, are dependent on agglomeration economies (i.e. spin off) for development of new products - hence path dependence is

experienced in those regions. The theory renders it seriously questionable cities can move from classification 5 to 4, from 4 to 3a, and from 3a to 2a. Rather, global cities tend to increase the degree to which they exercise control. European and nationally important cities with specialisation on innovative production structures are capable of that as well. Other cities however, can be considered to experience problems attaining innovative production structures because they have no critical mass.

In this section we have tried to argue that the rise of ICT-products raises the share of markets with path-dependent processes in the economy. Once certain suppliers (be it in product, location or other markets) attain critical mass, they will experience increasing returns to scale. The process of dividing market shares becomes self-enforcing. The city is confronted with such processes in two ways: first, price-competing firms tend to locate in other areas than product-competing firms. Second, the city itself is a marketed product with highly complicated technological features. This concerns mainly the location dicision by firms and individuals. Whenever urban govemment wants to alter path-dependent processes, it will have to do so rigorously. The costs of making demanders overcome network effects must be considered high. Aggresive policy, however, must be seen as highly complicated to achieve. Urban administrations are pathdependent thernselves in the light of the incentives by urban bureaucrats. The goals set by urban govemment are highly compatible; without a workforce, no enterprises will locate. Without reasonable job perpectives, citizens, though not perfectly mobile, want to migrate elsewhere. The city can thus attain critical mass in this respect. Cities that do will prosper, cities that do not might experience persistent problems only to be improved by aggressive, costly policies. One could even ask in some cases whether policy has any use at all. This question will be further addressed in the next section on the basis of a comparative study on urban developments in Berlin and Amsterdam.

4. A Comparative Case Study of Amsterdam and Berlin

In the preceding section we have described the nature of path-dependent processes, and argued that they are, once in function, difficult to change. In the case of urban policy, there are many driving forces that cannot be influenced by the administration. By way of comparative illustration, we will discuss here the cases of Amsterdam and Berlin.

It appears useful to examine cities with different historica1 backgrounds and dynamics to identify pathdependent processes in urban development. The analysis was based on structured interviews with urban policy-makers. The interviews were subdivided into six parts:

- Introduction
- Genera1 questions on the problems facing the city
- ICT and urban development
- New ICT in the professional context
- Changes in urban administrations and politics
- Conclusion.

The interviews are, of course, not appropriate to derive statistical statements. The aim is to arrive at a qualitative assessment of the perceptions by and approaches of legislators conceming urban structure, history, and administration in the light of the new ICT opportunities. We will now first present our findings from Amsterdam and Berlin in a carcise form.

Amsterdam

Urban labour market policy in Amsterdam is formulated as a centralised activity. Lower levels of administration implement policy instigated by the national govemment; measures conceming job-related education, for example, are purely directed by national instruments (Van Dam 1992). Urban planning in the Netherlands has got a long history; it is formulated rather centralised as well. Three reasons can be mentioned (Cohen and Nijkamp 1999):

- The fact that large parts of the country are below sea leve1 implied, historically, a long struggle against water. The maintenance of the water system caused a strong centra1 planning tendency.
- The high population density in and around Amsterdam causes land use to have high opportunity costs
- Income and economic activity discrepancies between the Randstad and the rest of the country are perceived as unpleasant in the politica1 arena, implying interference with market forces.

However, decentralisation is an ongoing process now, but stil1 with communities implementing the programmes of the state, heavily dependent on it for finance. Specific payments contribute a large share of bugets, limiting policy freedom severely (Van den Berg *et* al. 1998). Within the administration of Amsterdam the economic development department *(Dienst Economische Zaken)* and the physical department *(Dienst Ruimtelijke Ordening)* are responsible for planning, the former for enterprise location and the latter for spatial planning. Their competence overlaps, however. To provide firms with a single communal reference point, a dedicated service for enterprise location has been established in February 1998. Ten years ago, district administrations *(stadsdelen)* were created to improve service to the citizens.

Urban policy in Amsterdam stresses the lack of space, environmental decay, traffic congestion and employment mismatch as main current problems. A relatively large amount of unemployed persons are low qualified, whereas there is a deficit of high qualified workers. Amsterdam performs particularly well as a national and intemational finance centre and location of European headquarters of firms (over 200 foreign firms and 62 banks are located in Amsterdam). The lack of space creates an administrative problem as well: Amsterdam's communal competence is insufficient to deal with many interdependencies. The city's image is perceived as having structurally improved during the last decade. The interviewers had highly different opinions, however. The administration's image is perceived as slow and bureaucratic. Housing and accessibility must be seen as problematic. Still, Amsterdam benefits of the appreciation of urban life.

The ICT revolution is perceived as improving efficiency in the administration; similarly the economy is seen as more dynamic. Firms develop, move and decline much faster. All respondents agreed on the notion that increased ICT use would only foster mobility; as Amsterdam has neglected public transport for 20 years, traffic problems will only increase. Nevertheless, Amsterdam has a long history of media processing, and the culture to deal with ICT is perceived as good. Indeed, the city comprises one of the five main global connection ports for the World Wide Web. The administration itself may have to develop toward a project-based unit, as forma1 competencies are too rigid to allow for the high degree of interdependence of many policy issues. ICT can be used to foster service towards citizens, but its use should not be overestimated, because ICT penetration is stil1 low. ICT poses compatibility problems; various parts of the administration have different systems, with the result of problematic communication. On the other hand, as technological development proceeds rapidly, it is perceived as useful to foster creativity by subsidiarity in systems adoption.

Main critical factors in the future will be national decision-making on urban land, e.g. Schiphol airport, and the degree to which Amsterdam can stay connected to the global network. The city cannot reach the critical economic base of London, Paris of Frankfurt, but with respect to its size, its control capacity is remarkably high. It is a challenge to maintain and expand it.

Berlin

Urban development planning in Germany is up to states and communities; its organisation differs consequently. The German system stresses self-govemment. Since 1990 Berlin is organised as a city-state (Bundesland). Its legislative body is responsible for both communal and state tasks; the *Landesplanung*, is under its jurisdiction, and subject to the goals set in the federal *Raumplanung*. Those tasks are subdivided into the following departments, the *Senatsverwaltungen:*

- Labour, professional education and women
- Construction, housing and traffic
- Finance
- Public health and social issues
- Intemal affairs
- Justice
- Schools, youth and sports
- Urban development, environment and technology
- Economy and enterprise
- Science, research and culture.

The number of administrations was already cut down in 1992, and its planned to be reduced to 8 by the end of 1999. The mayor is less powerful than the prime ministers of other states – every member of the senate is fully responsible for his/her own administration. The senate only determines in case of disagreements among senators. Berlin has 23 districts (*Bezirke*). However, a reorganisation is planned, reducing the number of districts to 12 by the year 2001, in order to relief the financial base by reducing personnel and rationalise on service products and decision-making.

Berlin's relatively independent position is mirrored in its considerable legal competence conceming labour market policy. The latter kept many East Berliners from unemployment during the post-reunification years. The amount, however, is declining. In June 1997 it was under 40.000, coming from 100.000 in 1993. Berlin's Senate uses 4 types of labour market policy:

- Additional financing of federal labour market programmes
- Enterprise-orientated labour stimulation
- Professional advanced education
- Measures for integration of particular groups.

Conceming the first type, national labour market policy concemed over 50.000 persons in 1997. It involves temporally limited projects, wage subsidies for social services in the public sector, stimulation of further education and training, cyclical measures, pension measures, and new instruments with respect to training for long-term unemployment persons experiencing difficulty to reintegrate, pilot-wise employment, and subsidies for founding firms. Stil1 the part of labour market policy that aims at (re) integrating workers in the labour market is small, and many measures have an ad hoc character. However, the workforce of West Berlin is now signified by a disproportionate share of low qualified workers, that of East Berlin by many high qualified workers.

The administration in the city stressed sometimes highly different problems, including the stagnating economy, the rapid pace of polarisation and sub-urbanisation, the large difference between East and West, the lack of concepts for stimulating Berlin's economy, and the problems with respect to adaption to the new conditions after reunification. High unemployment and employment mismatch, though, are seen as central. ICT-related individualisation of work is seen as a threat to the city, but it is believed that urban areas stil1 play major roles, as face-to-face contact cannot be replaced by ICT. There is uncertainty on ICT-induced developments. ICT is seen as clearly increasing efficiency, both in the private and public sector. But as the financial base of Berlin is poor, the administration is the last one to adopt it. Much technological knowhow and competence were traditionally outsourced to private firms. It is thus improbable that the administration will integrate ICT in all its activities.

Synthesis

Amsterdam has faced rapid divergence of the national unemployment rate during the early 1980s. Policy in the 1960s and 1970s fostered capital-intensive production structures. The bankruptcies of the early 1980s can be seen as a response to the abolition of such policy (though the national economic crisis was a major cause as well). Here is a good example of path-dependent economic development. However, after 1984 renewed interest in Amsterdam can be observed, conceming citizens as well as firms. Though the communal administration is highly restricted to conform itself to national policy, its efforts in acquiring control functions can be seen as succesful. Amsterdam seems to have critical mass: urban administrators trust on good policy enabling Amsterdam to be a major hub in the ICT network. Favourable location factors here are, apart from the core city, the good accessibility in the intemational context, the intemational education system and a rather high qualified labour force. Moreover, many firms with high control capacity already reside in Amsterdam; certainly more than one would expect from a fairly smal1 city.

This case provided a good example of the notion that leading cities in the global network are internally polarised; though Amsterdam's economy performs well, the rate of unemployment among the low qualified stays high, at some 20%. It confirms that effective policy cannot rely on multiplier effects of locating firms in the services sector. Moreover, Amsterdam is confronted with a spatial problem. Two reasons are the geographic location of the city between waters, and the well-developing economy itself. The effect is, first, that housing construction becomes problematic to such an extent that new quarters are now built in water, and second that the administrative borders do not allow Amsterdam to grow. The increasing returns of the city in the light of firm location will increase the severity of this problem. There is certainly no space to locate industrial firms. To conclude, although

Amsterdam is a promising city in the global network, the perspectives for unemployment policy are not necessarily great.

During the decades of politica1 separation, the dynamics of Berlin's economy became static. Policy implied normally unprofitable production to stay. After 1989, all sorts of catching up trends emerged: fast sub-urbanisation, skyrocketing unemployment figures, and rapid decline in the possibilities for policy. The urban financial base is at historica1 depths now. However drastically and painfully, the structural change did not leave policy paradigms unaltered. Urban policymakers aim at qualitative measures, which provide the appropriate incentives, instead of relying on subsidies by higher levels of government. All relevant divisions of the administration stress supporting only knowledge-employing enterprises. Certainly, ICT-based firms provide, if succesful, the city with more dynamics. Offices require cleaning, it is said, so low-qualified labour benefits as well. There are multiplier effects. But it is questionable whether such policy will raise employment in all sectors, and policy does not seem to address low-qualified and long-term unemployment in particular. The sectoral division of labour gives the idea that policy will only lead to mismatches on the labour market. Furthermore, the city has no particularly advantageous climate to innovative firms in the German context. The knowledge pattem among workers appears overestimated. Innovative firrns have no incentive to locate in a fairly peripheral place like Berlin, and the proximity to the federal govemment does not seem to be attractive to them, neither does the objective of becoming an East-West focal point. Eastem Europe can be seen as a peripheral region with a comparative advantage for price-competing products. Wages in Eastem Germany are quite rapidly catching up compared to Eastem Europe, so Berlin does not have an advantage in price competing products. It has, though, a fluid labour market due to high unemployment. But that is common in Eastem Germany.

Berlin has no critical mass. Indeed, the city has the intemal polarisation characteristics of large cities, but intra-urban polarisation is not to the city's advantage. Headquarter location pattems do not imply a structural increase of Berlin's importance in the European urban system; rather the contrary. It is interesting though, how the govemment's move to Berlin will influence the economy. There is potential of workers in the public sector, but ICT enables many firms to stay far from govemment and stil1 have intense communication. The number of firms planning to locate in Berlin is not promising. Innovative employment seems thus the appropriate way, but. it is not successful because this is not extensively applied. Policy may have to be more intense, but experience with subsidies, the serious problems with Berlin's fmancial base, and the comparably lowqualified parts of the labour force prevent this. Berlin is stil1 under the influence of its history, and the emerging picture is a confirmation of the urban hierarchy set out above.

Comparing the two cities, the following theses appear to be confirmed:

- Cities in the global network are intemally polarised
- Polarisation between cities tends to strengthen, in a pathdependent process
- Increasing returns in enterprise location are highly determining
- Even in cities with critical mass, it is difficult to lower low-qualified unemployment
- Acquisition of firms in the services sector does not suffice as an employment policy
- The perception among urban policy-makers differs; some even reject the notion of an information society
- Policy is too gradual, and too difficult to adjust due to institutional frameworks.

5. Concluding Remarks

Developed economies experience an economic revolution. It is commonly named the ICT revolution. This revolution changes location factors. Location factors are not completely determined on the basis of geographical, predetermined circumstances, neither are they determined purely on the basis of economies of agglomeration. The ICT revolution tends to raise the importance of agglomeration economies because technologically competing products require large initial investments and knowledge. The importance of geographically determined location factors decreases because communication possibilities lower transaction costs dramatically. The consequent global scope of markets renders enterprises and citizens footloose with respect to their physical environments. Nevertheless, the importance of face-to-face contact remains. Physical transport is certainly not becoming irrelevant. Rather, the need for physical transport increases because more transactions become profitable.

However, the increased relative importance of economies of agglomeration causes a path-dependent, self-enforcing process of concentrating economic activity and growth in places that already attained critical mass. These places are, in the ICT era, likely to be cities. Cities have a comparatively fluid labour market, and concentrate knowledge. But their established economic structure is of importance: knowledge and physical infrastructure, and policy. Among cities, those that already have critical mass of productcompeting enterprises and a high-educated workforce tend to attain most economic activity. Small, exogenous events can be determining in attaining and losing critical mass. Those cities not having critical mass face decline. Industrial employment, traditionally locating in cities because of the large workforce offered, declines as rationalisation replaces man by machine, and footloose firms can choose where to produce most profitably on a global scope. A path-dependent process of enterprise location is determining the European urban system.

European cities emerged mostly on the basis of geographical factors allowing profitable trade. Politica1 factors were important to attract workers. The concentration pattem of economic activity and growth in Europe has been fairly constant since the emergence of cities, the main area being an axis stretching from South England via the Dutch Randstad cities and the German Ruhr area to North Italy. The Industrial Revolution saw economic activity shifting toward cities with a large, flexible workforce and considerable domestic markets. The Electric Age strengthened the stress on large scale. The decades since 1970 have seen a shift of employment to higher qualified jobs and an accelerating shift from industrial employment toward services employment in Europe. Additionally, increased mobility enabled suburbanisation. Industrial cities face decline, whereas cities with innovative milieus, large controlling competence and a sophisticated workforce (implying critical mass) gain importance. The path-dependent process leads to divergence, inducing different employment outlooks for different cities and for different groups within cities. The dialectic of the ICT era is not between employers and employees, but between those who possess knowledge and intelligence, and those who do not. Second, it is between those employed and those unemployed. The most problematic group is that of the low-educated unemployed. Unemployment among these groups tends to reinforce itself, as they stay unemployed longer. Employed workers have enough critical mass, be it in the form of special interest groups, trade unions or independently, to keep unemployed workers from being a competing factor. Moreover, unemployed persons lose knowledge, and they have no means and incentives to form a special interest group.

This observation confronts urban employment policy-makers in different ways. Because employment processes are path-dependent and bureaucrats are regarded as self-interested representatives of cities competing for enterprises and citizens, policy is pathdependent too. The appropriate difference is between cities with critical mass, and cities without critical mass. Because enterprises with supradomestic control functions will not locate in the latter places, unemployment is likely to reach high levels in all sectors and among all qualifications. On the other hand, price-competing products tend to be produced in peripheral regions. Assuming that the feature 'without critical mass' overlaps with "peripheral", such cities can attain lowqualified employment, assumed they offer possibilities for low-tost production. Economic growth worth mentioning is not to be expected of this kind of employment, and firms can migrate as soon as a more profitable region is perceived. Policy aiming at locating such firms is not reliable because the resulting economic activity is not of a character implying structural growth. On the other hand, policy just aiming at attracting dynamic, innovative firms cannot be seen as providing sufficient employment to low-qualified

workers. Cities possessing critical mass are confronted severely with unemployment among the low-qualified as well, because pricecompeting firms will perceive locating there as too expensive.
Any policy trying to address unemployment will, in the light of the path-dependent employment response to technological developments, have to be:

- *Pro-active.* It appears particularly problematic to provide a countervailing power against competitors with critical mass in an undesirable way, and attaining critical mass is highly dependent on extemal factors. Higher levels of administrations, notably the national states, do mostly not allow for such policy, moreover
- *Flexible.* Because pathdependent processes are uncertain in early stages, it is appropriate to try do direct them in a desired way. It is important to address exogenous events as fast as possible
- *Targeted.* Unemployment pattems are subject to structural differences likely to increase. There is no use trying to fight these for individual cities, i.e. peripheral areas are very unlikely to succeed in attaining innovative enterprises offering high-qualified employment.
- *Structurul.* The use of ad hoc subsidies is useless; it is even harmful, as it deprives firms of the right incentives. Policy should aim at providing firms and citizens with the right urban knowledge and physical infrastructure.

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